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CONTENT CENTRIC NETWORKING ALGORITHM TO AVOID PACKET LOSS

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ABSTRACT

Rapid developments in the mobile technology have transformed mobile phones into multimedia devices. Due to these advancements, user created mobile content is on the increase, both in terms of quality and quantity. In addition, content sharing is getting popular in home networks as well as in social community networks. To keep pace with such a movements the new networking topology named as content centric networking (CCN) optimized for content sharing has appeared. Due to mobility of intermediate nodes, connection between two remote nodes fails frequently bringing packet loss problem. Packet loss cause communication delay, throughput degradation and congestion and may even make the network unusable. This project proposes a new CCN scheme with packet loss avoidance built into it. The proposed scheme here addresses two mobility possibilities that cause packet loss: an intermediate node moving away from its initial location in this case packet loss is avoided by using the alternative path and broadcast, and movement of destination node in this case the destination node will receive the broadcasted data packet from the nearby node as the data is cached by the nodes in the broadcast. To further reduce the packet loss and delay in CCN, this work contributes the stable route path route selection. As the stable route is considered in path selection, the proposed system take smaller average delay and high packet delivery ratio than the existing system due to the node broadcast the packets to find path towards the content server. This algorithm is implemented over the MANET network and simulated using Network Simulator (NS2). Performance of the proposed system evaluated based on the parameters such as round trip time, packet delivery ratio and cache hit ratio and delay.

KEYWORDS: CCN; Link Failure; Link Recovery; Reduce Packet Loss & Delay; Stable Route

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Original Article

INTRODUCTION

CCN is a new communication paradigm that has been designed to substitute the current Internet. When compared to the current TCP/IP communication model, CCN has the following different characteristics:

- **Receiver-Centric Communication Model:** Receivers pull information by sending an interest message. At most one data message is delivered in response to an interest.
- **Hierarchical Content Naming Scheme**: CCN does not address specific hosts, but content object itself. Content is given hierarchical names, which is similar to URLs. Interest packets are forwarded by doing longest-prefix Matching at forwarding decision phase.
- **Cache and Forward Architecture:** Every CCN devices can cache data and use them to serve future requests.

CCN communication is driven by the consumers of data. There are two CCN packet types, Interest and Data. A consumer asks for content by broadcasting its interest over all available connectivity. Any node hearing the interest and having data that satisfies it can respond with a Data packet. Data is transmitted only in response to an Interest and consumes that Interest. Since both Interest and Data identify the content being exchanged by name, multiple nodes interested in the same content can share transmissions over a broadcast medium using standard multicast suppression techniques.

EXISTING SYSTEM

The CCN in mobile environment, a mobile device X sends interest packets towards the original source Y. As the interest packets are forwarded via the network, they traverse through several CCN devices. Data packets from content source are routed back along the path that interest packets are traversed. Each CCN device along the path stores the forwarded data packets from the content source to content requester.

For example, the CCN networking device, which is located near the old location of mobile device X, does not know the movement of the device X. So, data packets are unnecessarily transmitted around the old location of mobile device X. Moreover, interest packets are repeatedly transmitted after handover to request data packets that were already requested at the old location. That is, after handoff event, a number of redundant interest packets have to be sent again to retrieve the already-requested data packets. However, as data packets stored near the old location are not available until routing table update, the re-requested data packets after handover are delivered from the remote-located original content holder, not from nearby CCN device with cached content. So, it results in long latency and too much control overhead during device movement.

Drawbacks

- It does not provide the packet avoidance mechanism.
- High transmission delay and overhead.

LITERATURE SURVEY

Title: CHANET: A Content-Centric Architecture for IEEE 802.11 MANETs

Author: Marica et al.

A Content centric fashion MANET (CHANET) provides more features as it build on to the concept of a simple CCN. It uses broadcast packets, allowing for simplicity, availability and robustness. To face scalability issues and reduce collisions due to broadcasting, it takes advantage of overheard packets. Forwarding decisions are locally taken at each receiving node without any explicit signaling exchange with neighboring nodes. It indirectly implements traditional transport functions like sequence control and retransmissions requests by embedding acknowledgments in the Interest packets. It implements techniques to face mobility of consumers and providers. CHANET nodes can take the benefit of shared communication medium, so that broadcasted packets may be opportunistically received by more consumers simultaneously. But computing or updating distance tables by constant overhearing is not an efficient approach and the proposed scheme can avoid packet loss more efficiently in a network with mobile nodes during data communication phase by doing a controlled broadcasting of the packet.

Advantages

- Reducing collisions.
- Scalability is achieved.

Disadvantages

- High transmission delay
- High Overhead due to broadcasting packets.

Title: DSR: The Dynamic Source Routing Protocol for Multi Hop Wireless Ad Hoc Networks.

Author: David B. et al.

DSR is a typical routing protocol for MANETs. When a source node wants to find a route to another one, the source node initiates a route discovery it broadcasts a Route Request(RREQ) to the entire network till either the destination is reached or another node is found with a fresh enough route to the destination and each node appends own identifier when forwarding RREQ. After destination node received the first RREQ it sends RREP is on a route obtained by reversing the route appended to receive RREQ. The DSR protocol is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network.

Advantages

- It allows nodes forwarding or overhearing packets to cache the routing information in them for their own future use.
- It avoids the need for up-to-date routing information in the intermediate nodes.

Disadvantages

- Stable caches will lead to increased overhead.

Title: Ad-hoc On-Demand Distance Vector Routing

Author: Perkins CEo et al.

In AODV, a source node initiates route discovery when it needs to communicate with a destination for which it does not have a route. Route discovery is initiated by the source node broadcasting a route request message (RREQ) that contains a request ID. If a node receives a RREQ that it has received previously, it drops the request. Otherwise, it stores the address of the node from which it received the request. In this manner, a reverse route to the source is established. If the RREQ reaches the destination node or a node that has a route to the destination, the node sends a route reply message (RREP) to the source. Intermediate nodes that do not have a path to the destination re-broadcast the request when they receive it for the first time. As the RREP is sent back to the source, each node stores the address of the node that sent the reply. The forward path determined from the source to the destination is used for sending packets to the destination. AODV uses sequence numbers maintained for the different destinations so as to guarantee freshness of routing information. AODV nodes offer connectivity information by broadcasting local Hello messages.

If a node has not sent a broadcast within a specified time interval, it broadcasts a Hello message. Thus, a node can have a local table that contains all of its neighbors.

Advantages

- AODV provides loop-free routes even while repairing broken links.

Disadvantages

- A problem with the route discovery methods of current on-demand routing protocol AODV, is that it uses flooding.
- Nodes re-broadcast route request messages that they receive, however they limit the number of these messages only by not re-transmitting route request messages received more than once.

Title: On-demand Multipath Distance Vector Routing for Adhoc Networks.

Author: Marina et al.

This literature develop an on-demand, multipath distance vector routing protocol for mobile ad hoc networks. Specifically, it propose multipath extensions to a well-studied single path routing protocol known as ad hoc on-demand distance vector (AODV). The resulting protocol is referred to as ad hoc on-demand multipath distance vector (AOMDV). The core of the AOMDV protocol lies in ensuring that multiple paths discovered are loop-free and disjoint, and in efficiently finding such paths using a flood-based route discovery. AOMDV route update rules, applied locally at each node, play a key role in maintaining loop-freedom and disjointness properties. AOMDV relies as much as possible on the routing information already available in the underlying AODV protocol, thereby limiting the overhead incurred in discovering multiple paths. In particular, it does not employ any special control packets. In fact, extra RREPs and RERRs for multipath discovery and maintenance along with a few extra fields in routing control packets (i.e., RREQs, RREPs, and RERRs) constitute the only additional overhead in AOMDV relative to AODV.

Advantages

- AOMDV uses multiple diversity paths for data forwarding concurrently, so reduce the communication delay in manet.

Disadvantages

- AOMDV use only link disjoint paths, it leads to packet loss under high traffic network.

Title: Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers

Author: Charles E, Pravin Bhagwat.

An ad-hoc network is the cooperative engagement of a collection of Mobile Hosts without the required intervention of any centralized Access Point. This literature present an innovative design for the operation of such ad-hoc networks. The basic idea of the design is to operate each Mobile Host as a specialized router, which periodically advertises its view of the interconnection topology with other Mobile Hosts within the network. This amounts to a new sort of routing protocol. This system have investigated modifications to the basic Bellman-Ford routing mechanisms, to make it suitable for a dynamic and self-starting network mechanism as is required by users wishing to utilize ad-hoc networks. The modi

cations address some of the previous objections to the use of Bellman-Ford, related to the poor looping properties of such algorithms in the face of broken links and the resulting time dependent nature of the interconnection topology describing the links between the Mobile Hosts. Finally, this system describe the ways in which the basic network-layer routing can be modified to provide MAC-layer support for ad-hoc networks.

Advantages

- The proposed mechanism is adopted in dynamic mobile environments.

Disadvantages

- It does not provide the packet avoidance mechanism.

PROBLEM STATEMENT

- Routing is difficult in MANET because mobility may cause radio links to break frequently. Mobile nodes keep changing their position in an unpredictable manner. A routing algorithm must keep track of the destination's position and modify routes whenever the old routes become stable. In a high mobility MANET, although every mode can move freely, they usually follow some mobility patterns. Fast changes of topology increases the complexity of routing. Location information of each mobile node should be important for routing. It may also cause routes to be broken more often, and re-routing becomes more frequent**.** It becomes a time consuming process if the communicating route fails frequently.

PROPOSED SYSTEM

The main proposal of a new CCN scheme is to ensure better performance in the core of the network. A new content centric networking scheme to avoid the packet loss in CCN MANETs using proactive routing protocol. It avoids interest and data packets loss using different methods, by considering special properties of CCN. The proposed content centric network, the Content Requestor is requested the content to Content Server via intermediate nodes. If an intermediates nodes which having the content and there is cached data, then it reply the Data packet (contains content data) using the nexthop to Content Requestor. But if the next hop node is marked as unreachable, the node searches its FIB table again and use the alternative nexthop node to the destination. If all alternative next hop nodes are unavailable or there is no alternative path towards the content server, then the node broadcasts the Interest packet with fixed TTL value. When a node caching the content data, it looks up the next hop node in its pending Interest table and forwards the data packet to content requestor. But if the next hop node is unreachable and the link is broken that causes data loss, the proposed scheme uses broadcast to reach nodes that may have pending Interest with same content name. If any of the node receiving data packet having pending Interest with same content name, it also update the content of data in content store. To further reduce the packet loss and delay in CCN, the proposed system stable path selection techniques contributed. As the stable route is considered in path selection, the proposed system take smaller average delay, high throughput and high packet delivery ratio than the existing system due to the node broadcast the packets to find alternative path towards the content server.

Advantages

- Reducing unnecessary Interest retransmission
- Retrieving content with shorter latencies.

CONTRIBUTION

Stable Route Path Selection

In MANETs, one of the major issues is how to avoid packet loss due to frequent link failure caused by the mobile nodes in network, this proposed system contributes, a new mechanism for routing in MANETs that selected routes having more stability. A route which is selected for an adequate amount of period for transmission is defined as a stable route in MANETs. The proposed system, a strong reliable route from source to destination is selected based on the received signal strength. The strong signal denotes that the neighbor node is in communication range and link will be possible for longer time duration and the weak signal denotes that the neighbor node moving away and link will be failed soon. The received signal strength is calculated with the help of distance of receiver from the transmitter.

As the stable route is considered in path selection, the proposed system take smaller average delay and high packet delivery ratio than the existing system during no alternative path towards the content server then the node broadcast the packets to find path towards the content server. It can increase the delay and also reduces the packet delivery ratio in finds the path towards the content server.

Architecture

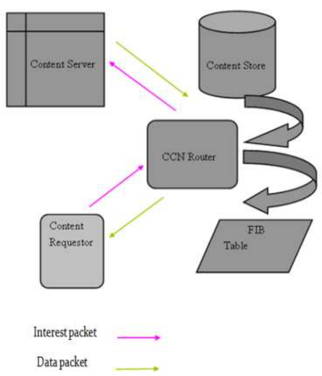

Figure 1

Block Diagram

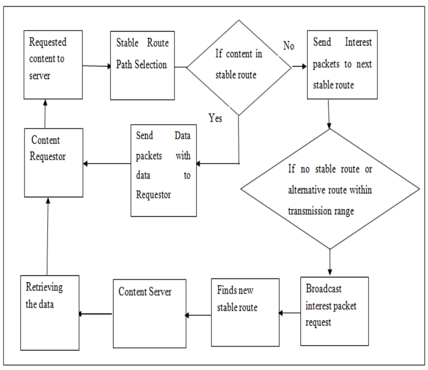

Figure 2

SOFTWARE REQUIREMENTS

Software: Cygwin

Simulator: NS version 2.35

Language: TCL

Operating System : Ubuntu/windows 7

Simulation Model

Table 1

SIMULATOR	Network Simulator 2
NUMBER OF NODES	Fixed
TOPOLOGY	Fixed
INTERFACE TYPE	Phy/WirelessPhy
MAC TYPE	802.11
QUEUE TYPE	Droptail/Priority Queue
QUEUE LENGTH	200 Packets
ANTENNA TYPE	Omni Antenna
PROPAGATION TYPE	Two ray Ground
TRANSPORT AGENT	UDP
APPLICATION	CBR

Modules:

Module 1: Interest Packet loss avoidance-Alternative Path Selection

Input: Requested content, Content Requestor and content server

Output: Alternative Path Selection

In content centric network, the Content Requestor is requested the content to Content Server via intermediate nodes. The CCN (content centric network) contains two packet types, Interest and Data. A Content Requestor asks for content by broadcasting its interest over all available connectivity. Any node hearing the interest and having data that satisfies it can respond with a Data packet. Otherwise, a node receiving an Interest packet, it first checks its cache. If the content is not available in its cache the node then searches in its FIB table for the next hop, with least hop count to destination, and forwards it if it is available. But if the next hop node is marked as unreachable, the node searches its FIB table again and uses the next best available route (Alternate path) to the destination.

Module 2: Interest Packet loss avoidance-Broadcast

Input: Unreachable Alternative Path Selection

Output: Broadcast Interest Packet

The alternative nexthop node is selected for content requestor, if all alternative next hop nodes are unavailable or there is no alternative path towards the content server, then the node broadcasts the Interest packet with fixed TTL value to prevent flooding. Because of frequent mobility of nodes and change of topology in wireless networks, new nodes that lie in a path towards the content server but with no path entry in their FIB table may arrive in the vicinity of the current node. This broadcast scheme uses the newly arriving nodes as a bridge to reach nodes in the path to destination server with an existing entry in their FIB table.

In broadcast side, the nodes that received the broadcast packet first check sequence number and TTL value of the packet. If the TTL value is not zero, the same content request with similar sequence number was not received and the requested content isn't available in its content store, then the receiving node calculates defer time and starts overhearing. After the defer time expired and confirming that no other node has forwarded the same packet, it decrements its TTL value, checks its routing table and forwards it to next hop if available or broadcasts it otherwise.

Module 3: Data Packet loss avoidance

Input: Requested or cached data

Output: content data transfer from content server to content requestor via intermediate Nodes.

When a node receives data packet from content server or intermediate nodes, it looks up the next hop node in its pending Interest table and forwards the data packet to content requestor. But if the next hop node is unreachable and the link is broken that causes data loss, the proposed scheme uses broadcast to reach nodes that may have pending Interest with same content name. If any of the node receiving data packet having pending Interest with same content name, it also update the content of data in content store. Newly arriving nodes or other intermediate nodes will further broadcast the data packet to their neighboring nodes, increasing the probability of reaching nodes that lie in the path of the original Interest request. Similar to Interest packet, the data broadcast packet also has sequence number to prevent duplicate broadcast and fixed TTL value to minimize flooding in the network.

Module 4: Stable Path Selection

Input: Unreachable Alternative Path Selection

Output: Broadcast Interest Packet via Stable Path Selection

In MANETs, one of the major issues is how to avoid packet loss due to frequent link failure caused by the mobile nodes in network, this proposed system contributes, a new mechanism for routing in MANETs that selected routes having more stability. A route which is selected for an adequate amount of period for transmission is defined as a stable route in MANETs. The proposed system, a strong reliable route from source to destination is selected based on the received signal strength. The strong signal denotes that the neighbor node is in communication range and link will be possible for longer time duration and the weak signal denotes that the neighbor node moving away and link will be failed soon. The received signal strength is calculated with the help of distance of receiver from the transmitter.

Modules 5: Performance Evaluation

Input: Node speed, Number of packets generated, received and velocity.

Output: Round trip time, Packet Delivery Ratio and Average cache Hit ratio and delay.

The simulation of proposed protocol is performed using Network Simulator (ns-2). Performance of the network is evaluated from the simulation results in terms of Round trip time, Packet Delivery Ratio and Average cache Hit ratio and delay. In the proposed protocol, CCN with packet avoidance packet delivery ratio increases up to a certain velocity compared to the packet delivery ratio typical CCN.

PDR

PDR is the proportion to the total amount of packets reached the receiver and amount of packet sent by source. If the amount of malicious node increases, PDR decreases. The higher mobility of nodes causes PDR to decrease.

$$\text{PDR (\%)} = \frac{\text{Number of packets successfully delivered to destination}}{\text{Number of packets generated by source node}}$$

Delay

Delay is the time taken for a packet to reach the destination from the source node.

$$\text{delay (s)} = \frac{\sum \text{(Delay for each data packet)}}{\text{Total number of delivered data packets}}$$

Round Trip Time

It is an average time of all successfully delivered user requested data.

Average cache Hit ratio

The probability to obtain a cache hit all along the path from a requester to a cache node.

PERFORMANCE EVALUATION

Network Architecture

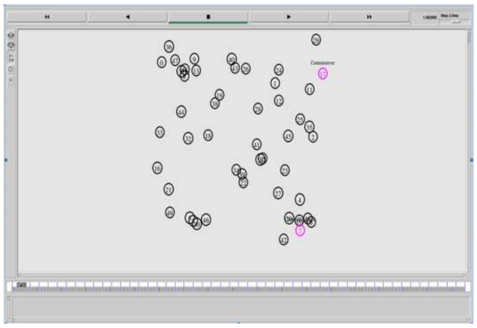

Figure 3

Interest Packet Avoidance

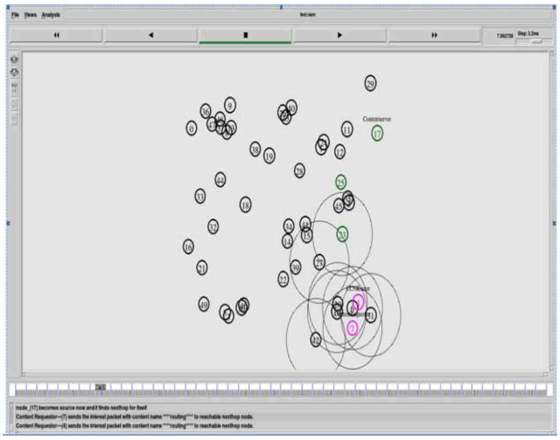

Figure 4

CONCLUSIONS

The proposed CCN scheme with packet loss avoidance scheme addresses two mobility possibilities that cause packet loss: an intermediate node moving away from its initial location in this case packet loss is avoided by using the alternative path and broadcast, and movement of destination node in this case the destination node will receive the broadcasted data packet from the nearby node as the data is cached by the nodes in the broadcast. To further reduce the packet loss and delay in CCN, this work implements stable route path selection. Performance evaluation is done based on the results of the simulation done using ns2. From the results it is proved that the route reliability and packet delivery ratio has been improved using this protocol.

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